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Science and Art Gossip.

IT is arranged that the lectures to be given by Mr. Proctor at St. James's Hall shall be the following:—

Wednesday, March 21, "The Birth and Death of Worlds."

Wednesday, March 28, "The Sun—Ruler, Light, and Life."

Wednesday, April 4, "The Moon—Planet and Satellite."

Saturday, April 7, "The Planets and their Families."

Wednesday, April 11, "Comets and Meteors."

Saturday, April 14, "Glories of the Star Depths."

The lectures will be illustrated by the oxyhydrogen light, showing more than 200 photographic views.

WE shall give next week the first of a series of illustrated papers on the "Way to Use our Eyes," by Mr. John Browning, F.R.A.S., which all who value their eyesight should carefully study.

PRESSURE of other matter has hitherto prevented our commencing the publication of Mr. Foster's papers on certain social questions, but these will soon be begun; and the papers on "How to Get Strong" will very soon be resumed.

ON the twelve large maps of "The Stars in their Seasons," are named the days and hours, from eight in the evening till midnight, at which the stars are situated as shown in the map; and in a little table on page 6 of the letterpress, the information necessary for using the maps at any time of the night is given. This is, of course, more than sufficient for all uses to which the maps are to be applied. Unfortunately, in the three lines footnote, added in an excess of zeal, to right and left of each map, giving the times two hours earlier and two hours later, the words "earlier" and "later" somehow got interchanged. The mistake is not likely to have done any harm, as it is so obviously contradicted in the maps themselves; and it will be corrected in later editions. But those who possess "The Stars in their Seasons" will do well to interchange the words "earlier" and "later" in these paired footnotes in all twelve maps.

IN response to the wishes of a number of correspondents, an offer has been made to Mr. Hampden (in the columns of this week's *Newcastle Weekly Chronicle*) to present, succinctly and without denunciation, the real and unadulterated theory of the earth's flatness, as maintained by the astronomers of the Zetetic school. Our Paradox Column now awaits his contribution, should he see fit to send one.

IT is stated that the Edison incandescent lamp is to be introduced into the corridors and passages of the House of Commons. The gas inside the House is said to satisfy every requirement.

RAILWAY wheels with paper bodies are being used on the Saarbruck Railway, and are expected to be adopted on a large scale in Germany, as better than other wheels for running on the iron permanent way, of which there is now considerably over a thousand miles in use in Germany.

MESSRS. A. L. NIMMO & C. MINNS state that the Tilbury and Gravesend Tunnel, for which they are engineers, and which will connect the London, Chatham, and Dover and the South-Eastern Railways with the Tilbury and South-end Railway, near the new Tilbury Docks, will pass under the river wholly in the chalk.

MR. JAY GOULD is trying to improve New York morality. He gives as a reason for stopping the late trains on the elevated road the statement that "The night trains are conducive to late hours and dissipation. If they do not run, people who would do otherwise will go home, and the tone of society will be improved." The citizens fail to appreciate this moral reform agency, and are petitioning the Legislature to compel the company to accommodate those whose business requires late trains.—*Engineer.*

LAST year, according to the *Industrie Zeitung*, 1,790 shipwrecks occurred, in all seas, as against 2,039 in 1881, 1,680 in 1880, 1,688 in 1879, and 1,594 in 1878. These wrecks, 576 of which were on the British coasts, involved the loss of 4,129 men's lives. During the last five years no fewer than 21,763 men have perished by sea.

THE SUEZ CANAL.—The revenue of the Suez Canal experienced a further very remarkable increase last year. The annexed figures show the transit revenue of the canal year by year during the ten years ending with 1882 inclusive:— 1873, £915,839; 1874, £994.375; 1875, £1,155,452; 1876, £1,199,000; 1877, £1,311,093; 1878, £1,243,929; 1879, £1,187,442; 1880, £1,592,419; 1881, £2,050,974; and 1882, £2,421,835. The temporary check experienced in the revenue in 1878 and 1879 was due to a reduction of duties, which appears, however, to have greatly stimulated business between British India and the mother country. This, at any rate, is the conclusion which *Engineering* draws from the largely augmented earnings of the canal in 1881 and 1882.

THE LIGHTING OF HOLBORN-VIADUCT.—The Edison Company have received permission from the Commissioners of Sewers to continue the lighting of Holborn-viaduct by their system for one year from the 24th ult.

XUM

Australian Artesian Wells.—A new artesian well at Sale, with its outflow of over 400,000 gallons of water a day, rising 12 ft. above the surface, is a great success. The town is jubilant over the supply of pure water thus easily and cheaply obtained. The recent sinking of an artesian well by Mr. De Renzil Wilson on Tatara Run, near Curriwillinghi, on the New South Wales side of the Queensland boundary, where at the depth of 200 ft. a spring was tapped which forced itself to the height of 15 ft. above the surface, and at the estimated rate of 500 gallons per minute, is even a more gratifying success.—*Engineering.*

A contemporary says: "A telegram has been received from Prof. Lomström, chief of the Finnish Meteorological Observatory at Sodankylä, in which he states that he placed a galvanic battery with conductors covering an area of 900 square mètres on a hill, and found the cone to be surrounded by a halo which faintly but perfectly yielded the spectrum of the aurora. He regards this, and some subsequent results, as direct proof of the electrical nature of the aurora.

The question of the hovering of birds is now under discussion in the columns of a weekly scientific contemporary. Mr. Hubert Airy seeks to show that a bird can only hover, in an absolutely changeless position, over slantingly ascending air currents, head from the wind; the Duke of Argyll maintains that horizontal air currents suffice, head to the wind; Mr. David Cunningham believes that cyclonic winds, with vertically ascending air currents, explain the mystery best; Mr. William Galloway adopts a theory involving slight and therefore imperceptible descent in horizontal air currents; Mr. J. Rae believes that no air currents at all are necessary (which seems to involve the theory that the hovering of birds is miraculous); and Mr. Larden, pointing out that the lifting power of the air would not exist were there no friction (any more than a "frictionless ship in a constant stream" would be moved "were it sufficiently tapering"), shows that hovering in horizontal air-currents could last but a very short time. This is a very pretty problem as it stands; and the whole question of flight—at least, as birds fly, and as men, by aid of machinery, will fly, if they ever fly at all—is involved in it.

Advices from Sydney say that on the night of the 12th December last an accident happened, by which the offices of the Telephone Exchange Company, at Sydney Exchange, were wrecked. The wires leading to the switch-board were partially fused, and the switch-board itself charred, the centre of the roof of the office blackened, and the floor bespattered with melted gutta-percha. Outside, the telephone wire which leads to Messrs. Montefiore, Josephs, & Company's establishment was found hanging down, fused, while the electric-light wires were all secure. Messrs. Montefiore, Josephs, & Company's wire hangs above and across the electric-light wires, and it is presumed that it elongated and made contact with them.

A correspondent of *Nature* calls attention to the circumstance that the authorities of Cooper's Hill Engineering College make it a condition that the Professor of Physics should "be a Protestant, and should attend morning chapel and Sunday services with reasonable regularity, showing in this respect a good example to the students." "As the memorandum stands at present," this correspondent wrathfully remarks, "it appears little short of insulting to men of science." The institution being one supported by the State, and the State being at present unwilling to insist that paid teachers of science shall hold any specific religious belief, still less that they shall profess such belief without (perhaps) holding it, the objection of the correspondent of *Nature* seems sound enough. But were the Engineering College not supported from without, the authorities there might insist on any Professor holding or professing any belief they chose. The only drawback would be in the probable quality of the Professor; for one would say that even if a Professor of adequate skill chanced to be of the right religious persuasion, he would take the offer of the Professorship on such a condition, if not as insulting, yet at least as one he could not possibly accept, if he had any self-respect.

Mr. Nicols, in his recently-published work on the ways of wild and domestic animals, gives the following account of the love dances of a king lory, which may be compared usefully with what Mr. Grant Allen told us last week about the peewit:—"In a few minutes he flew on to a tree, well within range of the binocular, and shortly afterwards a female joined him in answer to his call. The swain was ardent, the damsel coy; they flitted from branch to branch, and whenever she perched he circled round her, threw himself underneath the branch, and swung to and fro with outspread wings, displaying the full glory of his scarlet breast. In every movement, whether on the wing or swaying at the end of a bough, he studied to present in the most effective manner the brilliant adornments of his plumage. . . . . I do not think it possible for any one who had seen this little episode in bird life to have resisted the conclusion that the male was conscious of his beautiful breast, and that he adopted the best method of showing it by swinging himself beneath the branch, whence the female could look down and admire the display."

We give this week a short paper from the *Newcastle Weekly Chronicle*, describing a way of lighting the sides of steamships, which would, we believe, diminish greatly the number of collisions at night and in thick weather. The *Times* of Thursday, the 8th inst., has an article, "from a Correspondent" (who might be the same writer, for aught we can say to the contrary), touching on the same subject. A correspondent of Knowledge has sent us two letters advocating the microscopical analysis of the sea water as a means of determining a vessel's approach to the shore at night or during fog, and the chemical analysis of the water to indicate proximity to another ship. We have not been able to find space for either letter, and must confess there seems to us something a little whimsical in both ideas. Imagine the officers of a ship engaged with a microscope over tubes and phials, or applying chemical analyses (espe-especially in broken weather). We have "been there," as Americans say—in a steamship, waiting about, a whole day and more, in dreaded proximity to a dangerous reef off the coast of California; and assuredly we did not wish to see the captain and officers turning from their seamanly duties to attend to microscopical or chemical analysis.

According to the experiments of M. Demarçay, the metals which are generally regarded as fixed, even iron, give out real vapours at relatively low temperatures. Cadmium, for example, volatilises at 257°, and zinc at 302°. Magnesium had already been found to be volatile below a red heat, when acted upon by water and chloride of silicon.

HERBERT SPENCER IN AMERICA.

By Rev. Minot J. Savage.*

A QUIET, modest, unassuming gentleman, with no assumption of greatness, with no air of pretence, with not the slightest approach to an appearance of patronage toward those who may be considered as less noted or great than himself, has been for the last two or three months seeking rest and refreshment here in America. Heard in public but once, seen in private only by a few, the country has still felt that a great man was here, a man like those to whom Emerson refers when he says, "A great man is himself an occasion." We have all felt this presence, and noted some indication of it now and then. For, when he has chosen to utter himself concerning the impressions that have been made upon him in this country, the whole nation has listened as though something were being said that was worthy of attention. The newspapers have caught it up; and all the leading organs for the expression of public opinion have commented on it, recognising the fact that here, at least, was something not to be passed by in silence.

This man, to whom we have been so ready to listen, has during the last quarter of a century wrought a work that, I think I may say, without exaggeration, has no parallel in the history of human thought. He has so wrought himself into the very fibre, the warp and woof of this modern world, that I can say of him, what can be said of no other man living, and what has never been said of any man who has ever lived: he has made himself so vital a part of science, of philosophy, of education, of the science of government, of sociology, of ethics, of religion—he has so mastered and entered into the possession of all these great realms of human thought and human life, which in their totality almost make up what is meant by life itself, that to-day no serious and intelligent thinker can discuss any important question pertaining to any one of these departments without being compelled to reckon with Herbert Spencer. You cannot discuss science, you cannot discuss philosophy, you cannot discuss education, politics, society, and the laws that underlie them, you cannot discuss ethics, you cannot touch the subject of religion, without either agreeing with or differing from this quiet scholar. And to have wrought himself so intimately and so essentially into the very life of the world—this, I say, is an achievement unparalleled in the history of human thought. I care not in which department you pick up a book to-day, you will find that the writer, if he comprehends his theme, is either working along the lines which Herbert Spencer has laid out, or else he is telling the world why he does not do so. He does not ignore him—he cannot ignore him. About a week ago it was my privilege and pleasure to join one or two hundred gentlemen in giving Mr. Spencer a public dinner in New York, on the eve of his departure. It was something striking and wonderful to see there the leading men of the nation in all departments of thought and culture, sitting at his feet and acknowledging his supremacy.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

III.—COOKING UNDER WATER.

NEXT to the boiling of water for its own sake, as treated in my last, comes the boiling of water as a medium for the cooking of other things. Here, at the outset, I have to correct an error of language which, as too often happens, leads by continual suggestion to false ideas. When we speak of "boiled beef," "boiled mutton," "boiled eggs," "boiled potatoes," we talk nonsense; we are not merely using an elliptical expression, as when we say "the kettle boils," which we all understand to mean the contents of the kettle, but we are expounding a false theory of what has happened to the beef, &c.—as false as though we should describe the material of the kettle that has held boiling water as boiled copper or boiled iron. No boiling of the food takes place in any such cases as the above named—it is merely heated by immersion in boiling water; the changes that actually take place in the food are essentially different from those of ebullition. Even the water contained in the meat is not boiled in ordinary cases, as its boiling point is higher than that of the surrounding water, owing to the salts it holds in solution.

Thus, as a matter of chemical fact, a "boiled leg of mutton" is one that has been cooked, but not boiled; while a roasted leg of mutton is one that has been partially boiled. Much of the constituent water of flesh is boiled out, fairly driven away as vapour during roasting or baking, and the fat on its surface is also boiled, and, more or less, dissociated into its chemical elements, carbon and water, as shown by the browning, due to the separated carbon.

As I shall presently show, this verbal explanation is no mere verbal quibble, but it involves important practical applications. An enormous waste of precious fuel is perpetrated every day, throughout the whole length and breadth of Britain and other countries where English cookery prevails, on account of the almost universal ignorance of the philosophy of the so-called boiling of food.

When it is once fairly understood that the meat is not to be boiled, but is merely to be warmed by immersion in water raised to a maximum temperature of 212°, and when it is further understood that water cannot (under ordinary atmospheric pressure) be raised to a higher temperature than 212° by any amount of violent boiling, the popular distinction between "simmering" and boiling, which is so obstinately maintained as a kitchen superstition, is demolished.

The experiment described in my last showed that immediately the bubbles of steam reach the surface of the water and break there—that is, when simmering commences—the thermometer reaches the boiling point, and that however violently the boiling may afterwards occur, the thermometer rises no higher. Therefore, as a medium for heating the substances to be cooked, simmering water is just as effective as "walloping" water. There are exceptional operations of cookery, to be described hereafter, wherein useful mechanical work is done by violent boiling; but in all ordinary cookery, simmering is just as effective. The heat that is applied to do more than the smallest degree of simmering is simply wasted in converting water into useless steam. The amount of such waste may be easily estimated. To raise a given quantity of water from the freezing to the boiling point demands an amount of heat represented by 180° in Fahrenheit's thermometer, or 100° Centigrade. To convert this into steam, 990° Fah. or 550° Cent. is necessary—just five and a-half times as much.

On a properly-constructed hot-plate or sand-bath, a dozen saucepans may be kept at the true cooking temperature, with an expenditure of fuel commonly employed in England to "boil" one saucepan. In the great majority of so-called boiling operations, even simmering is unnecessary. Not only is a "boiled leg of mutton" not itself boiled, but even the water in which it is cooked should not be kept boiling, as we shall presently see.

In order to illustrate some of the changes which take place in the cooking of animal food, I will first take the

* From a sermon delivered a week after the public dinner given to Mr. Spencer the day before his sailing from New York.

simple case of cooking an egg by means of hot water. These changes are in this case easily visible and very simple, although the egg itself contains all the materials of a complete animal. Bones, muscles, viscera, brain, nerves, and feathers of the chicken—all are produced within the shell, nothing being added, and little or nothing taken away.

When we open a raw egg, we find, enveloped in a stoutish membrane, a quantity of glairy, slimy, viscous, colourless fluid, which, as everbody now knows, is called *albumen*, a Latin translation of its common name, "*the white.*" Within the white of the egg is the yolk, largely composed of that same albumen, but with other constituents added—notably a peculiar oil. At present I will only consider the changes which cookery effects on the main constituent of the egg, merely adding that this same albumen is one of the most important, if not the one most important, material of animal food, and is represented by a corresponding nutritious constituent in vegetables.

We all know that when an egg has been immersed during a few minutes in boiling water, the colourless, slimy liquid is converted into the white solid to which it owes its name. This coagulation of albumen is one of the most decided and best understood changes effected by cookery, and therefore demands especial study.

Place some fresh, raw white of egg in a test-tube or other suitable glass vessel, and in the midst of it immerse the bulb of a thermometer. (Cylindrical thermometers, with the degrees marked on the glass stem, are made for such laboratory purposes.) Place the tube containing the albumen in a vessel of water, and gradually heat this. When the albumen attains a temperature of about 134° Fahr., white fibres will begin to appear within it; these will increase until about 160° is attained, when the whole mass will become white and nearly opaque. It is now coagulated, and may be called solid. Now examine some of the result, and you will find that the albumen thus only just coagulated is a tender, delicate, jelly-like substance, having every appearance to sight, touch, and taste of being easily digestible. This is the case.

Having settled these points, proceed with the experiment by heating the remainder of the albumen (or a new sample) up to 212°, and keeping it for awhile at this temperature. It will dry, shrink, and become horny. If the heat is carried a little further, it becomes converted into a substance which is so hard and tough that a valuable cement is obtained by simply smearing the edges of the article to be cemented with white of egg, and then heating it to a little above 212°.*

This simple experiment teaches a great deal of what is but little known concerning the philosophy of cookery. It shows in the first place that, so far as the coagulation of the albumen is concerned, the cooking temperature is not 212°, or that of boiling water, but 160°, *i.e.* 52° below it. Everybody knows the difference between a tender, juicy steak, rounded or plumped-out in the middle, and a tough, leathery abomination, that has been so cooked as to shrivel and curl up. The contraction, drying up, and hornifying of the albumen in the test-tube represents the albumen of the latter, while the tender, delicate, trembling, semi-solid that was coagulated at 160°, represents the albumen in the first.

But this is a digression, or rather anticipation, seeing that the grilling of a beefsteak is a problem of profound complexity that we cannot solve until we have mastered the rudiments. We have not yet determined how to practically apply the laws of albumen coagulation as discovered by our test-tube experiment to the cooking of a breakfast egg.

* "Egg-cement," made by thickening white of egg with finely-powdered quicklime, has long been used for mending alabaster, marble, &c. For joining fragments of fossils and mineralogical specimens, it will be found very useful. White of egg alone may be used, if carefully heated afterwards.

BICYCLES AND TRICYCLES FOR 1883.

By John Browning,

(*Chairman and Treasurer of the London Tricycle Club.*)

THE novelties in bicycles offered for the coming season are as yet but few. There has again been a decrease in weight in racing machines. Two full-sized bicycles were exhibited at the Albert Hall, one weighing 19 lb. and the other 21 lb. One, a 54-inch, made by the Coventry Machinists Company, I examined carefully. The workmanship was excellent, and, notwithstanding its wonderful lightness, I have little doubt it is capable of standing the strain it will be required to bear.

A contrivance for preventing a rider from taking a header over the handles deserves mention on account of its novelty. Many of my readers have probably seen public performances by trick riders on bicycles. In some cases in such exhibitions, the riders take the handles off the machines and ride without them, steering and balancing entirely by their feet. The handles of the machines fit on a square on the top of the head. The new arrangement I am describing is similar in construction, but, on being pressed firmly down, the centre or socket of the handle locks itself on a square spindle projecting from the head by means of a strong spring. Underneath the handle-bar there are two long, light levers. Upon pressing either of these upwards, the spring is released, and the handle-bar can be removed. The reason a rider goes over the front of a bicycle when anything checks his machine, is because he instinctively grasps the handles tightly. But in falling forward on a machine fitted as I have described, a rider's thighs would be brought into contact with the levers below the handles, these are lifted, and withdraw the spring-catch, and continuing the pressure, force off the handle-bar. The rider then falls on his feet, with the handle-bar in his hands. I would much rather see the inventor exhibit the action of this contrivance than experiment with it myself.

Kinnaird's new crank action, made by Keen & Co., of Norwood, is an elliptical motion of the pedals attached by two levers to the cranks. A pedal, with eight inches leverage, rises and falls only about four and a half inches. The mere saving of the unnecessary motion will represent a great saving of power in riding. This very ingenious contrivance admits of many applications. By its aid a tall man may ride a small bicycle, or a short man may ride a large bicycle. But probably its most important application will be to tricycles, as it will enable them to be driven without either chains or levers.

Having referred to such novelties as I believe will prove useful in bicycles, I will return to improvements in tricycles. And first I will refer in more detail to those machines I so briefly alluded to in my last article.

Of the Humber tricycle, I need only say that there seems but little room left to improve this machine, either for grace, speed, or lightness. I do not regard the machine as the best for general adoption. The machine known as the Lady's Humber, however, I can thoroughly recommend as one of the lightest, best, and safest front-steering machines made, equally adapted for ladies or gentlemen; and I would strongly urge its makers to bring it more prominently before the public.

Many riders have a predilection for a rear-steering tricycle; those who require this type of machine will find Burgess's "Sterling" tricycle, as constructed for this season, an admirable machine. I believe the machine to be as safe for running down hill as a front-steerer, while it is much easier to mount or dismount; it will receive luggage more conveniently, and it will carry the driver without splashing him over dirty roads, while a front-steerer will smother him with mud. The front wheels have ratchets, and the pedals may at pleasure be stopped and used as foot-rests. This is a great advantage when running down hill. I have found some difficulty in making many persons understand the advantage of Mr. Burgess's plan of pedalling backwards to go forwards; but I am sure my thoughtful readers of KNOWLEDGE will soon see the point. When pedalling forward with a crank action, each foot controls a pedal over little more than one-third of a revolution. When pedalling backwards, each foot has control over a pedal for a little more than half-a-circle. There are, therefore, no dead centres to get over—an inestimable advantage when riding uphill. Again, when pedalling backwards, each down-stroke of the foot presses the hind steering-wheel more firmly on to the ground, makes the steering more sure, and steadies the machine. Pedalling forwards would lift the hind wheel off the ground, render the steering uncertain, and the machine unsteady. The position of the seat when the rider has to pedal backwards, places him between the three wheels; this reduces the motion of the rider when passing over obstacles, and gives him the most perfect vertical action yet obtained.

In his admirable paper in *Good Words*, Dr. Richardson recommends tricyclists to use all their influence with manufacturers to induce them to adopt means for minimising vibration in tricycles. This has been done in the "Sterling" in the following simple manner. The seat is attached to two levers by means of straps, and these levers are attached to helical springs. The vibration is so much reduced that a rider may travel over a macadamised road in bad condition without inconvenience. The machine has a long backbone, which also tends to reduce vibration. The length of the backbone and the form of the frame cause this machine to be especially suited to carrying photographic apparatus. A case 18 in. square will hang easily underneath the machine without being in the way of the rider.

LEARNING LANGUAGES.

By RICHARD A. PROCTOR.

(*Continued from page* 66.)

THE HAMILTONIAN SYSTEM.

THIS system differs from the ordinary literal translation, in giving a truly literal translation, placed word for word under the words of the original, which are only so far changed in order as seems essential to the sense. Thus, take the following passage, with which Cicero's famous third oration against Catiline opens:—

Rempublicam, Quirites, vitamque omnium vestrûm, bona, fortunas, conjuges, liberosque vestros, atque hoc domicilium clarissimi imperii, fortunatissimam pulcherrimamque urbem, hodierno die, Deorum immortalium summo erga vos amore, laboribus, consiliis, periculisque meis, ex flammâ atque ferro, ac pæne ex faucibus fati ereptam, et vobis conservatam ac restitutam, videtis. Et, si non minùs nobis jucundi atque illustres sunt ii dies, quibus conservamur, quam illi quibus nascimur; (quod salutis certa lætitia est, nascendi incerta conditio; et quod sine sensu nascimur cum voluptate servamur): profectò, quoniam illum, qui hanc urbem condidit, Romulum, ad Deos immortales benevolentiâ famâque sustulimus; esse apud vos posterosque vestros in honore debebit is, qui eandem hanc urbem conditam amplificatamque servavit.

The Hamiltonian translation of this passage is presented as follows:—

Quirites, videtis rempublĭcam, que vitam vestrûm
Romans, you see, the republic, and the life of you
omnium, bona, fortunas, conjŭges, que vestros lĭbĕros,
all, goods, fortunes, wives, and your children,
atque hoc domicilium clarissimi imperii, fortunatissi-
and this abode of a most-famous empire, a most fortu-
mam que pulcherriman urbem, ereptam ex flammâ
nate and most beautiful city, snatched out-of flame
atque ferro, ac pæne ex faucibus fati, et
and sword, and almost out-of the jaws of fate and
conservatam ac restitutam vobis, hodierno die,
preserved and restored to you, on-this-day,
summo amore immortalium Deorum
by the highest (very great) *love of the immortal Gods,*
erga vos, meis laboribus, consiliis que periculis. Et
towards you, by my labours, counsels, and dangers. And
si ĭi dĭes quibus conservamur sunt non mĭnùs
if those days in which we are-preserved are not less
jucundi atque illustres quàm illi quĭbus nascimur;
pleasant and illustrious than those in which we are-born;
(quòd lætitia salutis est certa, conditio
because the joy of safety is certain, the condition
nascendi incerta; et quòd nascimur sine
of being-born (*is*) *uncertain; and because we are-born without*
sensu, servamur cum voluptate): profectò quoniam
feeling, we are preserved with pleasure: truly because
sustulimus illum Romulum, qui condidit hanc urbem,
we have-raised that Romulus, who founded this city,
ad immortales Deos benevolentiâ ac famâ:
to the immortal Gods with benevolence and with fame:
is debebit esse in honore apud vos que vestros
he will-ought to be in honour with (*among*) *you and your*
posteros, qui servavit hanc eandem urbem
descendants, who has-preserved this same city
conditam que amplificatam.
being-founded and enlarged.

The method of this translation will at once be recognised. The aim is to be strictly literal; and the student is at once saved all trouble about the meaning of each word. In the above passage we may take exception to the translation of "quoniam" by *because* instead of *since*, and *will-ought* for "debebit" may perplex by being un-English; "*will owe* (ought)" would, perhaps, have done better. We see also, that in this, as in all other systems of translation, there is room for comment on the words used to represent the original. Thus the words "certa" and "incerta" are not fully represented by the English *certain* and *uncertain*—and though the attentive learner can hardly fail to notice this for himself, since the statement that "the condition of being-born is uncertain," is absurd, it would be well in all such cases to add a foot-note indicating the delicate shade by which the original differs from the nearest English for it. In the present case, for instance, the word "certa" indicates that the joy of safety is consciously recognised or ascertained;

the word "incerta" means, not that the condition of being born is uncertain, but that it is not a condition which is consciously recognised. Manifestly, our words "certain" and "uncertain" do not represent this shade of meaning; and the teacher (or a foot-note) should point out that even when these English words fairly represent the meaning of the Latin, the Latin word *certus* contains, over and above the idea of certainty, the idea of conscious ascertainment or discernment; and the connection between the words "certus" and "cerno" should be indicated. The exercise of the student's mind in noticing peculiarities of meaning in the corresponding words of different language might well detain him as long over each line of translation as the work of turning over a dictionary; but I venture to say very confidently that it is a much more improving exercise, and would much more rapidly advance not only his knowledge of the language he is studying, but also his progress in attaining that keenness of perception by which the true force of words and sentences is discerned.

The use of such a translation as the above is obvious. But the way in which I have myself used the Hamiltonian method may, perhaps, be worth explaining to the readers of Knowledge. It does not carry one quite so rapidly over the ground as one *may* go, should it be wished; but it is (to me) exceedingly interesting, and I believe it to be very instructive.

Take, then, first, such a passage as the above (German was the language I was studying, however) and go carefully over it, word for word as it stands. Thus, the above would be read as follows:—Quirites, *Romans*, videtis, *you see*, &c. Next, read it over several words at a time. After this, read the English through alone, and then turn to the original, and read that through. You will find that by this time you can read the original understandingly. Take the passage next (not more at a time than is given above) and turn it into English by a free translation—not too free, but just free enough to be good English. Now follows what in practice I found the most improving part of the whole work. Make a word-for-word translation in the exact order of the words in the original, and note what this tells you of the character of the idiom and also of the mental peculiarities of the nation who owned or own the language you are dealing with.

To do this for Latin, note that some words must be differently translated than they are above. Thus the best way of representing the enclitic *que* is by "also," and we are entitled to represent as the proper translation of "conservamur" *we-are-preserved*, though Mr. Underword separates the *we*, writing *we are-preserved*; for, the personal pronoun is in reality present in the termination, though in an archaic form nearer akin to the Æolic ἄμμες than to the Latin *nos*.

The translation, then, would run somewhat as follows:—

[The] Republic, Romans, [the] life also of-all you, goods, fortunes, wives, children also, yours, and also this abode of [a] most famous empire, most fortunate most beautiful also city, this-day's day, of the Gods' Immortal by highest towards you love, by labours by counsels by dangers also mine, out-of flame but also sword, and also out-of jaws of fate snatched, and to-you preserved and restored, you behold. And, if not less to-us joyful and illustrious are those days, on-which we are-preserved, than those on-which we are born—(because of-safety perceived [the] joy is, of-being-born unperceived [the] condition; and because without feeling we are born, with delight we are preserved),—assuredly, (since he, who this city built—Romulus—to [the] Gods immortal in-benevalence and in-fame we-have-raised,) to be among you, descendants also yours, in honour ought he, who [the] same this city—founded, enlarged also—has-preserved.

This translation should be read over two or three times in alternation with the free translation, and it should be noted in what respects the free translation fails, as all such translations must fail, to represent the original, and to give its full force.

In making such a translation, the student not only tests and renews his acquaintance with all the new words the passage contains, but learns much of the construction of the language he is engaged with. He notes in this particular case also, how the Romans in speaking, and, therefore, in thinking, preferred first to present the *object* with all that seemed necessary to be said about it, then the person or persons whose actions or relations towards that object are to be *indicated*, then the nature of those actions or relations. This is seen in parts of a sentence as in the whole sentence. The same turn of mind is shown also by the customary positions of noun and adjective in Latin; for though there is no such hard and fast rule in this respect as in French (for example), still the Roman would rather give his subject first and its attribute after, than reverse this arrangement as we English generally do. Where we would say, "The lively horse strives to throw his skilful rider," the Roman would prefer to say, "The rider skilful* of-him, the horse, lively, to throw strives.

Thus, in learning the language of a race, we may, if reflectively disposed, learn something also of their turn of mind.

(To be continued.)

ON THE FORMATION OF COMETS' TAILS.

By A. C. Ranyard.

At a meeting of the Astronomical Society in 1874, I suggested (see "Astronomical Register" XII. p. 80) a possible explanation of the repulsive force acting on the matter of comets' tails, which differs somewhat from that suggested by Mr. Grensted in Knowledge of Feb. 2. He assumes that space is filled with a universal atmosphere as attenuated as that within the bulb of a Crookes' radiometer, and that the force which drives back the matter of a comet's tail is due to inequalities in the pressure of such an atmosphere. Without making any assumption as to a universal atmosphere, I would suggest that the accumulated effect of the minute recoils accompanying evaporation, as molecules are thrown off from the surface of a small body towards the sun, is sufficient to account for the force which overcomes the action of gravity and gives rise to the enormous velocities with which matter is occasionally driven away from the sun in a comet's tail.

If one half of the mass of a particle is rapidly thrown off by evaporation towards the sun, with an average velocity (V), the remaining half not yet driven into vapour will have received a series of impulses all acting in directions nearly opposite to the source of heat, which will give a velocity comparable with V, away from the sun, to the

* I am aware that I have departed here from the usual order; I have done so because I am trying to convey rather the general idea than to indicate the actual practice in detail. The use of varying terminations in Latin renders the order of the words less important than in English. Thus, "The rider of him skilful, the horse," &c., would, in English, be understood to mean that the horse was skilful, instead of the rider; but there could be no such mistake in Latin.

remaining unevaporated half of the particle, and as the evaporation continues, the velocity of the unevaporated residue will increase, until it may become much greater than the velocity with which the gaseous molecules are driven off from the heated body.

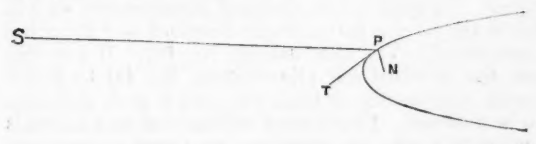
It is evident that evaporation will take place most rapidly where the sun's rays strike vertically; and if we suppose evaporation to take place so that the particles all fly off in directions which are inclined less than 45° to the line passing through the sun's centre, the resultant effect of all the recoils would give the unevaporated half of the particle a velocity greater than $\frac{V}{1{\cdot}42}$ in a direction away from the sun.

The velocity with which an evaporating molecule leaves the evaporating body must at least be equal to the velocity of the free molecule in the gaseous state immediately after evaporation. We know that the average velocity of hydrogen molecules at a temperature τ is $1{\cdot}06\sqrt{\frac{\tau}{273}}$ miles per second; where τ is the number of degrees centigrade measured from the absolute zero of temperature, and we consequently do not need to assume a temperature higher than the temperature of an English summer day to give a velocity of 1·1 miles per second for the molecules of hydrogen gas, which would correspond to a velocity of nearly a hundred thousand miles per day.

Hitherto we have only considered the motion due to evaporation of a part of the mass of the moving particle, but in the case of a gaseous mixture, where one element is precipitated by cold, while the rest remain in the gaseous form, we may have condensation going on on the shaded side of the precipitated particles and evaporation on the illuminated side, while the condensed matter continually flows round to the illuminated side, or the precipitated particles may be turned by the forces acting on their illuminated surfaces.

Prof. Arthur Wright, of Yale, has shown that when stony meteorites are heated to a temperature of only 100° C. a mixture of several gasses, carbonic dioxide, carbonic oxide, hydrogen, &c., is given off. In such a mixture at ordinary atmospheric pressure the carbonic acid would be condensed into the liquid form, at a temperature of about – 80° C., and in vacuo, the condensation would take place at a still lower temperature. We can, therefore, conceive of the action described going on at a very low temperature, and can understand the formation of comets' tails at distances from the sun considerably greater than the earth's distance.

An evaporating particle near to the comet's nucleus would be acted upon by four forces, viz., gravitation towards the nucleus and heat repulsion from the nucleus, gravitation towards the sun and heat repulsion from the sun. If the repulsive action is in each case greater than the attractive action, the particle will be driven towards a hyperbolic surface, which has the comet's nucleus in one focus and the sun's centre in the other focus.



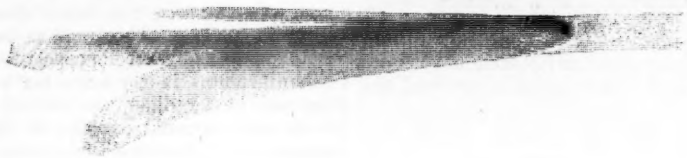
This is evident, for on such a hyperbolic surface, the tangent T P bisects the angle S P N. If the forces in the direction S P and N P are equal, the resultant will bisect the angle between them, and the particle will be driven along in the hyperbolic surface; while if the force in the direction N P is greater than the force in the direction S P, the particle will be driven outwards, till it reaches a confocal hyperbolic sheet, where the forces acting from the sun and nucleus are equal.

Particles of different sizes would be acted upon by gravitating forces corresponding to their masses—that is, by attractive forces varying with the cube of the diameter of the particle; while the repulsive forces would vary with the surfaces exposed to radiation, or as the square of the diameter of the particles. Consequently particles of different sizes, as well as substances evaporating at different temperatures, would be driven towards different confocal hyperbolic sheets, and as seen in projection, these would appear as hyperbolic envelopes one within the other. Such differences in the repulsive forces would evidently also account for differences of curvature in the plane of the orbit of different parts of the tail. Fan-shaped, intersecting arcs in front of the nucleus have frequently been observed, which may possibly be accounted for by supposing that hyperbolic envelopes about different nucleii are occasionally seen in projection one through the other. Probably all the phenomena of cometary structure cannot be accounted for on the above supposition, but I wish to point out that it is not necessary to call in a hypothetical electrical repulsive force in order to account for the chief features of cometary structure. Possibly, as Bredichin, Norton, and Zöllner have suggested, electricity may be generated as physical changes take place during the heating of the nucleus; and though I cannot accept their electrical theories with regard to the formation of comets' tails, I would suggest that it is possible that the bright line spectrum in the neighbourhood of the nucleus may be due to a rapid succession of electrical discharges, while the general temperature of the gas remains far below the temperature of incandescence.

If the earth had no atmosphere, a particle driven upwards from the earth's surface with a velocity of a mile a second would, under the action of terrestrial gravity, only rise to a height of 82 miles, and then fall again towards the earth; but a particle driven away from a nucleus weighing only a few pounds, or even a few million tons, with a velocity of a mile a second, would be driven off into space. It is evident that with temperatures such as we have been supposing, there would not be an atmosphere about a flight of meteoric stones similar to the earth's atmosphere, but the molecules would stream away with approximately parallel motions, and precipitated particles in the neighbourhood of the heated side of the nucleus would be bombarded with molecules of evaporating gases moving in very long free paths. This condition Mr. Crookes has termed "the fourth state of matter," and he has in a series of beautiful experiments shown that such a bombardment may be caused in a vacuum tube about a negative pole when a discharge from an induction coil is passing through the exhausted tube, and that bodies struck by particles of such radiant matter shine with a phosphorescent light which I conceive may be the cause of the intense brightness of the suspended matter in the neighbourhood of the nucleus, while the gaseous molecules during their long free paths would give out their own distinguishing wave lengths. Thus, without electrical discharges the whole phenomenon of the continuous and bright line spectrum in the neighbourhood of the nucleus may be accounted for.

The few observations I have made with regard to the polarization of the light derived from the tails of comets show that there is usually but little polarization in the neighbourhood of the nucleus, but in the further parts of

the tail the polarization is more or less intense, according to the position of the comet with respect to the earth and sun. If the line joining the earth and comet makes a small angle with the direction in which the sun's light falls upon the comet, the polarization is small, but the intensity of the polarization increases as the angle between the line joining the earth and comet and the direction of illumination increases towards a right angle. This seems to indicate that the polarization is due to the dispersion of the sun's light by particles whose diameters are small compared with the wave-length of light.



Great Comet of 1882, from a drawing by Dr. Temple, of Arcetri, 18 Oct. 16 h.*

The phenomena exhibited by the recent brilliant comet also affords evidence of matter streaming away from the brighter parts of the tail towards the sun. Mr. Gill's photographs, as well as the drawings by Schmidt, Temple, and others who observed in a clear atmosphere, show a broad band of faint light which is traceable backwards from the brighter parts of the tail far beyond the nucleus in the direction of the sun. The band evidently does not spring from the nucleus, as it is not symmetrically placed with respect to it, but it corresponds with the broader and brighter parts of the tail.

According to my theory, the sun must be constantly bombarded by matter driven off from every meteoric mass which comes into its neighbourhood, while a portion of the less volatile elements are driven backwards into space.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—VIII.

As we intimated in the preceding article, it is somewhat difficult to measure the resistance of coils to be subsequently used as measures of resistance in other wires. Our position is in some degree akin to that of a shopkeeper who has to make his own scales and weights, all he has to guide him being a single one-ounce weight. Given the ounce weight, he could make another similar weight by restoring to the scale, by means of a sufficiently large piece of metal, etc., the balance which had been upset by the original weight being placed in one of the pans. Further, he might possibly be able to produce his second weight by causing the first to do a certain amount of work, such as extending a spiral spring, and then modifying the dimensions of a piece of metal until it is able to repeat that work, and so indicate an equality in weight. The analogy in electrical measurement is very close. Instead of a pair of scales, we use a "differential" galvanometer, in which there are two coils of wire, each capable of exerting an equal but opposite force upon a magnetic needle suspended between them—that is to say, if a certain current traversing one coil deflected the needle through 30 deg. to the right, the same current passing through the other coil would cause a deflection of 30 deg. to the left. If the current is divided between the coils so as to pass through simultaneously or in "quantity," then there will be no movement of the needle, as the forces exerted are equal and opposite. This may be more readily comprehended by a reference to Fig. 1, in which Z C is the battery, the copper pole being "put to earth," and the zinc joined by wire to D, where the current divides betwen the coils A and B of the galvanometer G. After leaving these coils, the current passes direct to earth or back to the zinc pole of the battery. If now we insert a known resistance (y) between the coil A and the earth, it will be evident that the "balance" will be upset, and that as the circuit A has a higher resistance or lower conductivity than the circuit B, there will be an unequal division of the current, the smaller portion going through A, and exerting a comparatively feebler effect upon the needle, which is then deflected by the greater current circulating in B. In this case the deflection is produced by the difference between A and B, not by the whole current B, as the A current has still to be neutralised. Suppose, now, we insert an unknown resistance (x) in the B circuit between the galvanometer and earth, and increase that resistance until the needle again points to zero, it is clear that the two circuits again offer equal resistances, and that the unknown x is equal to the known y. The differential galvanometer is a very useful piece of apparatus, and will amply repay any trouble expended in making it. The coils should be so nearly equal as to be able to transmit a current from 40 or 50 Daniell cells without deflecting the needle.

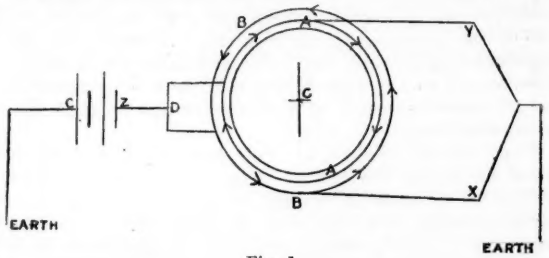


Fig. 1.

The other method available for the shopkeeper, we said, was to make the new weight repeat work done by the original. To apply this to electrical measurement, we will refer to the tangent galvanometer described in "Electrical Measurement.—VI." (Knowledge, No. 58). If a current from the standard cell (Knowledge, No. 44) be passed through the quantity or thick-wire coil, a good deflection will be obtained. The external resistance of such a circuit is practically *nil*. If, therefore, we insert between the battery and galvanometer a small resistance, it will materially reduce the strength of the current, and consequently the deflection of the needle. By noting the deflection resulting from the insertion of this known resistance, and

* The plane of the comet's orbit was inclined at an angle of about 38° to the ecliptic. The earth passed through the plane of the comet's orbit about the middle of September, so that at the date of the drawing a straight tail with a series of curved tails behind it in the plane of the orbit would be seen in projection as but slightly separated from one another.—A. C. R.

then substituting and modifying an unknown resistance until the reduced deflection is repeated, we can obtain a second resistance equal to the first. With these two known resistances, a third can be made equal to their combined resistance, and, with a little thought, all the required coils may be measured off.

A third method is by that known as the Wheatstone "bridge." This is of all methods the most universally applicable and satisfactory. By its means we are able to measure accurately and easily any resistance varying from a minute fraction of an Ohm to several million Ohms. There is very little new concerning the arrangement, but its interest and importance are of so vital a nature in all systems of measurement, that we fear no excuse we could urge would be sufficient to warrant our passing it by.

In Fig. 2, which illustrates the principle involved, the

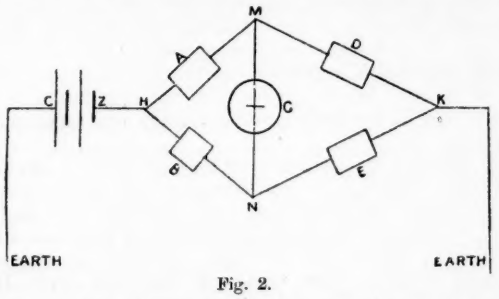


Fig. 2.

pole C of the battery is put to earth, or joined to the other earth-wire from K. A wire passes from Z to a terminal at H, where the current is divided, one part going through A, M, D, and the other through B, N, E to K, and thence flowing to earth or back to the battery. G is a galvanometer joined to the two wires from the battery at M and N. Ignoring for a moment the galvanometer circuit (M G N), it will be remembered that when a current is divided between two conductors, the proportion passing through them is inversely as their resistances. Furthermore, the electrical principle determining the current's flow is its potential or the intensity of its electrical charge. A current from C to earth or through K to Z is, therefore, an effort to establish electrical equilibrium throughout the circuit, and is the result of differences of potential in the various parts of the circuit. When a current thus flows, it is clearly passing from a high to a low, or may be to Zero potential (the nominal condition of the earth). In Fig. 3, Z C is a

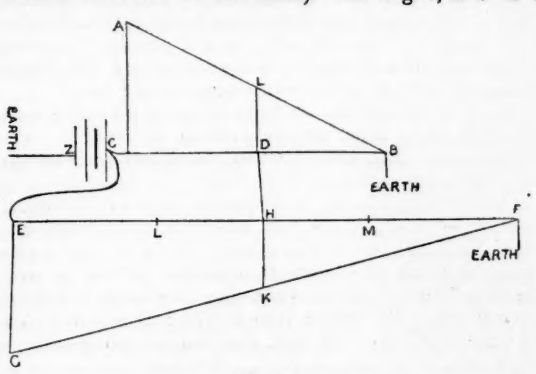


Fig. 3.

battery with Z to earth and C joined to the uniform wire C B, the end B being to earth. The vertical line C A may be made to represent the potential or electric charge at C, B (to earth) being Zero. Then the inclined line A B depicts the gradual fall of potential which takes place as the current passes along the wire. It is apparent that as D L is half the length of C A, the fall between C and D is equal to the fall between D and B. Next suppose we have a wire E F similar to C B, but twice the length. If we connect E to the C pole of the battery, the current will divide between the two wires, but the current in each wire will have the same electro-motive force (which, it must not be forgotten, is the difference of potential between the two poles of the battery). The vertical line E G must therefore be equal to C A, and E F being uniform there will be a gradual fall of potential from E through F to earth. If we draw from the centre H of the line E F a vertical line H K, that line will indicate that the fall of potential from E to H is the same as that from H to F. H K is, in fact, half the length of E G, and as it is also equal to D L, it implies that the fall between C D is equal to that between E H, and the fall between D B equal to the fall between H F. Let us now join D to H. It is clear that these two points are at the same potential—consequently, a current being the result of a difference of potential, there will be no current flowing through D H. If, on the other hand, the wire from D be joined to any part of E F other than H, there will be a current flowing. If joined to L, the current will flow from L to D, because L is at a higher potential than D. If joined to M there will be a current from D to M, because the potential of D is higher than that of M. This brings us back to Fig. 2, where M N is the wire joined to the two lines through which the battery current is flowing. G is a galvanometer with many turns of fine wire. If the resistance blocks A B D E are all equal—say ten Ohms each—the galvanometer needle remains steady, because the potentials of the points M and N are equal.

As we have already reached the limit of our space, we must defer a further consideration of this most interesting topic till our next article.

COLLISIONS AT SEA DURING FOG.

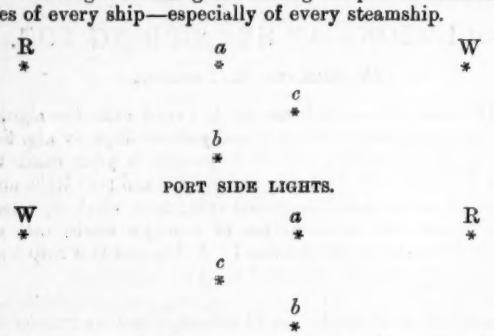
By Richard A. Proctor.

THE care with which money is saved over the signal-lamps of ships, &c.—especially steamships at night—is most praiseworthy. Several pounds a year must be saved by using only two side lights—the red port light and the green light on the starboard side; and what if, when a collision occurs, half-a-million of money's worth may go in a few minutes to the bottom? A ship lost is a ship lost, but economy must be attended to as all-important.

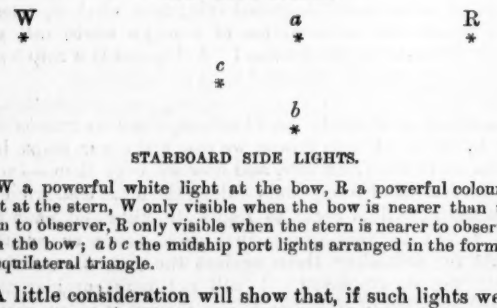
But, seriously, when we consider the power which science has attained over the forces of nature, when we remember how, by virtue of such power, we can make our ships independent of wind and tide, and how we urge them—each with its freight of living souls—along the great trade routes in hundreds, it does seem to imply stupidity and want of care, to say nothing worse, that such means as science affords for defending them against the risk of collision should not be employed. I will not here consider the general question of collisions at sea, though it is one about which much might be said. But such disastrous collisions as have occurred recently might easily be avoided, or at least rendered extremely infrequent, if proper means were used for indicating, by strong lights suitably placed, the position of steamships, whether in motion or at rest. Everyone who has traversed a thick fog, even a London

fog, since the electric light has been much used in towns, knows how much farther a strong electric light shows in a fog than the best gas-light, and (still more) than any oil-light. It is well-known, too, how much the use of any coloured glass diminishes the range of distance through which a light can be seen. Now, it may very well be that the general use of the electric light on board steamships may not be possible at present. I should have thought the owners of our best ocean steamships would long since have decided to use only the electric light for their signal-lamps, if not for illuminating purposes throughout those ships. But supposing this not yet possible or convenient, it is yet obvious that in every steamship, either slowed or brought to rest during fog, there is available a store of energy which might be well employed at those critical times to drive a dynamo machine and maintain any desired number of very strong electric lights in suitable positions. Such lights would penetrate to a considerable distance through any ordinary sea fog. If they had been burning on the *City of Brussels* and the *Kirby Hall*, or on the *Cimbria* and *Sultan*, it is, to all intents and purposes, certain that the late disastrous collisions would not have occurred. The mere indication of the presence or approach of these several ships would have sufficed to have averted the danger.

But more than this might very readily be done. The lights at present used are of very little service in indicating the position in which a ship lies. A red light shows that her port side would be in view were it day, but not *how* that side is presented. It may be the broadside which is towards another vessel, or she may be lying with her bows only so far turned to starboard from being directly end on that the slightest possible change in her course or bearing will bring the green starboard light into view. (Precisely such a change happened just before the *Cimbria* was run down.) Now there is absolutely no reason whatever (save the expense required for some eight or nine instead of two or three lamps) why this uncertainty should exist. Supposing only side lights can be used, instead of such central lights as might, perhaps, be hidden by sails or rigging, then what is to prevent such an arrangement as the following from being used along the port and starboard sides of every ship—especially of every steamship.



PORT SIDE LIGHTS.



STARBOARD SIDE LIGHTS.

(W a powerful white light at the bow, R a powerful coloured light at the stern, W only visible when the bow is nearer than the stern to observer, R only visible when the stern is nearer to observer than the bow; *a b c* the midship port lights arranged in the form of an equilateral triangle.

A little consideration will show that, if such lights were used, not only would the port side be distinguished as now and from the starboard one much more quickly, because white lights are seen much farther than coloured ones, but the exact bearing of the ship's midships would be at once shown by the foregoing shape of the triangle *a b c*.—*Newcastle Weekly Chronicle.*

THE ABUSE OF EVOLUTION.

By Richard A. Proctor.

SINGULARLY enough, when the kindly and sensible words of the American clergyman whose note on Mr. Herbert Spencer we give elsewhere, were passing through our hands for press, we were favoured, through the courtesy of the Editor of the *Christian Commonwealth*, with a specimen of a different kind of comment on the great philosopher of our century, and on his fellow-workers, Darwin, Huxley, Tyndall, J. Stuart Mill, and the rest. We do not propose in these pages to discuss the sayings of Mr. De Witt Talmage, of the Brooklyn Tabernacle. Knowledge would not be advanced thereby. He represents a type more common in America than in this country, though neither is the type, unfortunately, wanting here, nor is he himself personally unknown to us. His engagement to preach in various English cities on rather costly terms, and the energy with which he insisted on his bargain after it had appeared that his eloquence was not appreciated here, rankle still in the remembrance of many who engaged his services.

Mr. Herbert Spencer has recently paid a visit to America—a silent visit, till the earnestness of his friends there, including all the profoundest and ablest thinkers in the land, forced him at length to meet them and talk with them as a friend unto friends. Whether it was the contrast between this visit and Mr. De Witt Talmage's visit to England which moved the latter to speak, or only a happy accident, is a matter of small moment. It suffices that the preacher of the Brooklyn Tabernacle has delivered himself in terms which, while they display his own nature, were adapted, we must assume, to his hearers' tastes. It is difficult to say whether they are more strikingly contrasted with the teaching and methods of the writers he attacks, or with those of the intelligent, well-trained, and well-educated clergymen who have, indeed, dissented from some of the inferences which appear to them to follow from modern scientific theories, but who know well that they would but degrade their cause and themselves (to say nothing of their calling) were they to substitute reviling for rhetoric and railing for reasoning. Fortunately, the chief teachers of science and the ablest exponents of religion are alike, in our day, well-educated and well-mannered gentlemen.

After informing us that the doctrines of "Herbert Spencer and Darwin are out-and-out infidelity," without saying what he means by the word (the Christian is an infidel in the eyes of the Turk, and belief in the Trinity means infidelity towards Zeus and Aphrodite, towards Mumbo-Jumbo and Oa-Oa-Waramakoa), Mr. De Witt Talmage favours us with the following evidence:—

(1.) Of his *knowledge*,—"As to our race, we began with men 10 ft. high, and now the average is 5 ft. 3 in.; the ancients lived 300, 400, 600, 900 years, and the average now of life is less than thirty."

(2.) Of his *familiarity with modern theories of biological evolution*,—"First, there was vegetable stuff, perhaps a mushroom. That mushroom developed into something like a jelly-fish; and the jelly-fish developed into a tadpole. The tadpole developed into a snail. The snail developed into a turtle. The turtle into a wolf; the wolf into a dog; the dog into a baboon, and the baboon developed into a man."

(3.) Of his *taste*,—"Sing Sing" (a convict establishment in New York state), "and The Tombs," (a New York prison), "and Shoreditch, London, and Cowgate, Edinburgh, are only

vast carbuncles on the face and back of natural evolution. Give natural evolution full swing, and it would evolve two hemispheres of ——, two hemispheres of crime, two hemispheres of penitentiaries, two hemispheres of lazarettos, two hemispheres of ——." (The blanks represent coarse words, which we cannot quote, though the editor of the *Christian Commonwealth* seems to see no objection to them.)

(4.) Of his light and graceful *humour*,—"A dinner is given at Delmonico's last November, in honour of the great original discoverer of evolution. And the guests sat around the table eating beef and turkey and roast pig, according to the doctrine of evolution eating their own relatives, slicing their own cousins, picking the bones of their own uncles, and thrusting the carving-fork into the bosom of their own blood relatives, dashing Worcestershire sauce and bedaubing mustard" (Mr. Talmage's ideas of gentlemen at dinner are peculiar), "all over members of their own family."

(5.) Of his *regard for truth*,—"and while Herbert Spencer reads a patronising lecture on the American people, the American *savants* declare it is the voice of a God, and not of a man."

Mr. Talmage also gives evidence of the fervid eloquence with which he can preach (at one hundred pounds a night, with threats of lawsuit if the sum be reduced to forty pounds). But we *dare* not quote what he says in this way: all classes of our readers would be offended with his coarse and blatant nonsense.

Nearly three centuries ago there was at least earnestness in the arguments urged by priests, and monks, and friars against the fearful doctrine that the earth goes round the sun. Unwise though their conduct, and unjudging their intolerance, they believed what they taught, and in their day their belief was natural enough. It is encouraging to find that in our day the advance of science is only opposed by the untaught and the foolish, only abused by the ranter and the Jack-Pudding. When we consider how necessary now are certain doctrines for the world's welfare—even though hereafter they may have to give place to higher and broader and deeper truths—it is well to see that those who do their best to discredit those doctrines (as the priesthood did unwittingly when they opposed Copernicus) are not now men whose words have any weight, are not even fanatics or bigots, but simply—clowns and charlatans.

THE FACE OF THE SKY

From February 16th to March 2nd.

By F.R.A.S.

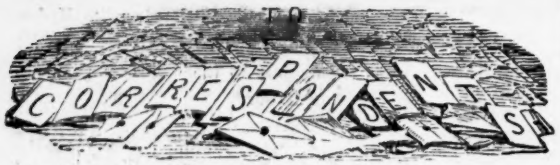
THE sun will be watched, as heretofore, for spots and faculæ. After sunset now, on clear evenings, the student should look out for that curious phenomenon, the Zodiacal light, in the W.S.-W. At first sight, it may well be mistaken for a rapid brightening of the twilight in the region in which the sun has just gone down; but a little attention will show that it is really a blunt luminous cone, whose axis corresponds very roughly with the direction of the ecliptic in the sky. An abstract of all that is known, or may reasonably be conjectured, as to the physical nature of this strange phenomenon, will be found on p. 163 *et seq.* of the "Essays on Astronomy," by the Editor of Knowledge. It may be worth while to mention that the conical or lenticular form of the Zodiacal light is best seen when the phenomenon itself is not looked at directly, but rather, in popular parlance, "out of the corner of one's eye." Viewed thus by indirect vision, it becomes very apparent. In the night sky, Böotes, Coma Berenices, and Virgo are rising in the east. Leo is just to the east of the Meridian, and Ursa Major very high up above it. Below Leo lies Hydra. On the Meridian are Lynx, Gemini, Canis Minor, and Monoceros. To the west of it lie Auriga, Taurus, Perseus, Cassiopeia, and Andromeda. Cygnus is setting just to the west of N., while to the east of it is Draco's head. The constellations we have enumerated may all be identified on Map II. of the "Stars in their Seasons."

Saturn, to the south-east of δ Arietis, is getting now very near the west, and will soon disappear for the season. Jupiter, brilliant and conspicuous above ζ Tauri, is visible during the whole of the working hours of the night. The phenomena of his Satellites are pretty numerous during the next fourteen days. To-night (16th) Satellite III. will reappear from occultation at 7 h. 3 m., only to plunge into Jupiter's shadow and be eclipsed at 9 h. 13 m. 20 s. It will reappear from eclipse at 11 h. 54 m. 13 s.; less than four minutes after which Satellite II. will be occulted. The night of the 18th, if fine, will be a prolific one for the student of Jovian phenomena. Satellite II. will begin its transit at 6 h. 26 m., followed by its shadow at 8 h. 50 m. At 9 h. 11 m. the Satellite will pass off the planet's limb, while at 10 h. 16 m. the transit of Satellite I. will begin, its shadow following it at 11 h. 29 m. The shadow of Satellite II. will pass off at 11 h. 36 m.; Satellite I. will do the same at 12 h. 32 m., and finally the shadow of Satellite I. will leave Jupiter's disc at 1 h. 45 m. a.m. on the 19th. The young observer should carefully note the colours both of Satellite II. and of its shadow. On the 19th, Satellite I. will be occulted at 7 h. 28 m., and reappear from eclipse at 10 h. 55 m. 29 s. Satellite II. will do the same at 6 h. 20 m. 36 s. on the 20th, the first Satellite leaving Jupiter's face afterwards at 7 h., and its shadow at 8 h. 14 m. On the 23rd Sat. III. will be occulted at 8.8 p.m., and reappear on the other side of the planet at 10 h. 52 m. It will afterwards suffer eclipse at 1 h. 14 m. 14 s. the next morning. On Feb. 25 Satellite II. will begin its transit at 8.58 p.m., its shadow not following it until 11 h. 28 m., sixteen minutes after which the Satellite will leave Jupiter's opposite limb. The transit of I. will begin eight minutes after midnight. Satellite I. will be occulted at 9.21 p.m. on the 26th, reappearing from eclipse at 12 h. 51 m. 15 s. On the 27th the ingress of this same Satellite will begin at 6.36 p.m.; that of its shadow at 7.53 p.m. The Satellite will pass off at 8.52, and its shadow at 10.9. Meanwhile, at 8 h. 56 m. Satellite II. will reappear from eclipse. The reappearance from eclipse of Satellite I. will occur on the night of the 28th at 7 h. 20 m. 9 s. Venus is a morning star, low down and less bright than she has been. We gave directions for finding Uranus on p. 75.

The moon is 8·7 days old on the 16th, and quite obviously 22·7 days old on March 2. She is full in Feb. 21, and enters her last quarter at 5 h. 26.1 m. in the early morning of March 2. She passes from Taurus across part of Orion into Gemini on the 16th, remaining in the last-named constellation during the whole of the 17th. She passes into Cancer on the 18th, and continues there on the 19th. Her path carries her into Leo by the 20th, but she travels out of it into Sextans on the 21st, returning into Leo again the next day. She passes from Leo into Virgo on the 23rd, remains in Virgo all the 24th and 25th, and the greater part of the 26th, travelling into Libra on the latter day. She is in this constellation during the whole of the 27th and during a good deal of the 28th, travelling into Scorpio as the month concludes. She is in the southern part of Ophiuchus on March 1. On Feb. 19 the sixth magnitude star BAC 2,872 will disappear at her dark limb at 5 h. 39 m. p.m., at an angle of 65° from her vertex, and reappear from her bright limb at an angle of 19°·1 at 6 h. 29 m. p.m. On the 20th ω Leonis will similarly disappear at her dark limb at 9 h. 6 m. p.m., at an angle from her vertex of 29°, reappearing from her bright limb at 10 h. 23 m., at an angle of 21°·6. The two or three remaining occultations occur at hours so inconvenient for the general amateur, for whom these notes are more particularly intended, that we purposely omit any details in connection with them.

M. Potel has recently submitted to the French Society of Encouragement a new substance, which he has named after himself, "Poteline," and which appears to be susceptible of numerous applications. It is a mixture of gelatine, glycerine, and tannin, and is, according to the inventor, absolutely impermeable to the air. When warmed it becomes liquid, or nearly so, and takes all the contours of an object. M. Potel has made corks of it, which form an economical substitute for metallic capsules, and secure a hermetic closing. He has used it as a coating to preserve meat. At a temperature of 112° it envelops the meat, kills the germs of putrefaction, and prevents any new germ passing in. According to M. Potel, meat thus treated will retain all its freshness for two months.

XUM



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

EDELWEISS.

[720]—In answer to "Corkonian's" letter (713), I think he will find that the scientific name for Edelweiss is:—"Gnaphalium leontopodium," and that Linnæus put it into Class 19, or. 2, Nat. or. Compositæ. Hermit.

[721]—The Americans have prophesied a disastrous storm and tidal wave for March 11 (two days after the new moon), when every ship at sea will be submerged and great damage be done on land.

Have our scientific people in England calculated that there will be any very abnormal tide about that time? If so, what will be the difference in time between its occurrence here and its occurrence in America? M. M.

[The prophecy is bosh.—R. P.]

GORSE AND BROOM.

[722]—I have been much struck with the beauty and instructiveness of Mr. Grant Allen's papers, "A Naturalist's Year."

Might I, through your kindness, ask his attention to two facts in reference to his fifth article, "Gorse Blossoms"? 1. The broom is hardly less successful in protecting its blossom than the gorse, at least not so in these Highlands. Both plants are, to the animals that browse upon them, for winter use. While the grass is green and the heather juicy, neither sheep nor deer will touch either broom or gorse; but when the heather gets hard and the grass withered, these animals look for subsistence to the juicy broom and the flowering furze. These plants defend their lives in different ways. The juice of the broom has something of a narcotic quality in it. At least, shepherds say that it makes their sheep sick or drunk. This is a well-known fact among shepherds; and it is certain that deer very soon get tired of it. This is the broom's self-defence, not for the seeds of that, but of the following season.

The gorse, on the other hand, is armed with its formidable prickles; but these do not so effectually protect it as the nature of its juice does the broom. Flocks of sheep and herds of deer rush to wastes covered with furze while the broom is scarcely touched. Hence it is that in deer forests every means is taken to propagate the gorse while the broom is left to take care of itself, and does it very effectually.

Second, there is an old saying, I don't know whether English or Scotch—perhaps both—to the effect: "Pluck broom hae broom; cut furze hae furze." It is difficult to pluck broom by the roots, hence its safety. It is easy to cut furze—all animals browsing upon it are doing so, hence its safety. J. G. M.

DARK SUNS.

[723]—Clifford says (*Fortnightly Review*, June, 1875):—"A great amount of light must be stopped by the dark bodies of burnt-out suns." Is this accurately put?—or rather, is there justifiableness? Faciebat.

[A great amount absolutely, but a very small amount relatively—most probably.—R. P.]

A DISINFECTANT.

[724]—A much cheaper disinfectant than that mentioned by Mr. Mattieu Williams at page 47, Vol. III., of Knowledge, is the chloride of lead. This is very simply made by dissolving half a dram of lead nitrate in a pint of boiling water. This is to be put, with two drams of common salt, into a pail, which must be filled with rain water, in the meantime stirring until all the salt is dissolved. The cost of lead nitrate is 8d. per lb., common salt ½d. per lb. This will make 256 pails of disinfecting fluid at a cost of 10d., or at the rate of very nearly thirteen for one halfpenny.

F. W. Cory, M.R.C.S. Eng., &c.

A PUZZLE.

[725]—A correspondent sends a solution of the following:—Twenty-one girls to go out three and three on ten days, no two being together more than once. A demonstration of the method by which the solution is obtained is promised. If not too long, I hope to be able to give both the solution and the demonstration.—R. P.

BRAIN TROUBLES.

[726]—I was away from my books at the time when some interesting letters appeared in your valuable paper on the above. I knew that Dr. Forbes Winslow had written a book on this subject, entitled, "On Obscure Diseases of the Brain," and his notes may be of value to the writers of the above letters. Such cases as they describe, the doctor calls "incipient symptoms of cerebral disease," and he advises the patients to put themselves under proper treatment. He quotes cases similar to those mentioned. For instance, one patient used to transform "flute" into "tufle," "gum" into "mug," &c.; another forgot names; another the first syllables of words. One curious case is worth mentioning: Mr. Von B——, envoy to Madrid, a man of a serious turn of mind, yet by no means hypochondraical, went out one morning to pay visits. At one house he had to give in his name, "but this he had at that time entirely forgotten." Turning to a friend, he exclaimed, "For God's sake, tell me who I am." The doctor says that no change may be noticed in mental powers, either by the patient or his friends, but "the change may have progressed insidiously and steadily, having slowly and almost imperceptibly induced important molecular modifications in the delicate vesicular neurine of the brain, ultimately resulting in some aberration of ideas or other disease.

I hope you will be able to find space for this note, as it may be of value to some of your correspondents. I would advise them to read the book; it is extremely interesting. Psychomantis.

[The correspondence about Brain Troubles arose out of my articles on that subject, republished in "Nature Studies." There is much reference there to Dr. Forbes Winslow's book, but I am rather careful to advise those who have slight brain troubles to avoid unnecessary anxiety. I have known cases where mischief has arisen from the nervous fear lest some mental trick should mean approaching cerebral disease. In most cases, change of employment, relaxation, light exercise, and so forth, will set all right.—R. P.]

LETTERS RECEIVED.

Regulus.—Fred. Lobintz.—J. H. Bridger.—Curate ("The Stars in their Seasons").—G. Clavering Mesnard (same book enlarged, and with more illustrations).—G. Hooper.—W. P. You misunderstand us both.—F. M. Sutcliffe. *Recueil Choisi* excellent.—A Cockney.—Edith Dalton.—E. C. Hooton.—Peccavi.—E. D. G. Suggestion, "redde" for "read" *past*, good. Opinions about logic less useful than facts or reasoning. How much better a letter than anonymous note on post-card.—Trisectus. Bisectus, if your trisection valid.—Undergraduate. Clifford in error, G. Darwin right.—H. M. Parkhurst. First syllogism impossible: hence incredible result.—Excelsior. Thanks.—H. L.—R. Morham.—W. W.—Jas. Graham. Powerless.—T. W. "The Naturalist's Year" will probably be republished. Mr. Allen retains all such rights.—E. J. Castle. Problem has often been reduced to that degree.—J. E. Earing.—German.—W. Buchanan.—W. H. W. M. Canadensis.—Peccavi.—Young Astronomer.—W. H. Brown.—J. Boots.—R. B. Blackmore.—Rev. M. Allanson.—J. J. Robertson.—Mat. Duffy.—Prawns.—Lieut. Binnie.—The Elms.—An Admiring Student.—Samson Harlowe.—Tourniquet (what a *dreadful* story!).—N. L. L.—A Publican.

Erratum.—In Admiral Sullivan's letter on "Transit of Venus," in last week's Knowledge, p. 90, at fifth line below the engraving, read "brightest colour being *near the* planet." The words italicised were accidentally omitted.

Our Mathematical Column.

COMPOUND PROPORTION.

(*Concluded from p. 93.*)

WE may, however, change the way of arranging our numbers for multiplying and dividing—though I do not think we improve them—so as to be more in accordance with what is taught in the books and expected (I suppose) in examinations. The numerators in our fractions are of course what we multiply by, in effect, and the denominators are what we divide by. Thus, instead of putting down fractions as we did, with numerator at the top and denominator at the bottom, we may set all our multipliers, or what would be the numerators in the other arrangement, in one column, and all our divisors in another; while we may set to the right of both columns the quantity which has thus to be multiplied and divided.

Thus our first sum in compound proportion might be arranged thus:—

	Mult.	Div.	
	17	10	17 ft.
	5	6	
	Mult.	Div.	
Our second thus:	10	17	17 days.
	6	5	
	Mult.	Div.	
Our third thus:	23	17	6 hrs.
	10	13	

This is the usual way of arranging the figures; and though I prefer the other, as more in accordance with common sense and with practice in other cases, it is easy to apply common sense to this arrangement too. Thus, we first write Mult. over the multiplying numbers, and Div. over the dividing numbers,—say in first question. Then we reason thus:—changing 10 men to 17 will *increase* the work done *in this degree*, so that we must *multiply* by the *larger* and *divide* by the *smaller* number; so we set 17 under Mult. and 10 under Div. Again, changing 6 hrs. to 5 hrs. of working will tend to *diminish* the work done in the *same degree*, therefore we must multiply by the *smaller* and divide by the *larger* number; so we put 5 under Mult. and 6 under Div. Since, however, our answer is thus seen to be

$$17 \text{ ft.} \times \frac{17 \times 5}{10 \times 6}$$

it seems better to write it down so at once, putting 17 and 5 above the line, 10 and 6 below, instead of under the respective headings of the other arrangement.

The same method applies to every case of double, triple, or multiple rule of three, or compound proportion. No technically-worded rule whatever is wanted, but the simple consideration of the effect which the various changes indicated in the question must produce.

I take a somewhat less simple problem, to show the working of this common-sense process of reasoning. I do not use columns, though those who are going in for examination may use that plan as more commonly known to examiners. I simply set all the *multipliers above* a line, and all the *dividers under* the line as in the usual way of treating the multiplication of fractions or ratios.

Suppose the following problem,—

Problem. *If* 7 *men working* 5 *hrs.* 15 *m. a day for* 16 *days dig* $13\frac{1}{4}$ *acres, in what time will* 5 *men, working* 6 *hrs.* 18 *m. a day, dig* $12\frac{1}{5}$ *acres.*

Noting that 5 h. 15 m. = 315 m., 6 h. 18 m. = 378 m.

$$13\tfrac{1}{4} = 13\tfrac{3}{12} = \tfrac{159}{12}\text{; and } 12\tfrac{1}{5} = 12\tfrac{4}{12} = \tfrac{148}{12}$$

our answer is

$$16 \text{ days} \times \frac{7 \times 315 \times 148}{5 \times 378 \quad 159}$$

We write down first the 16 days, because it is about days that our problem deals; we see that *reducing* the number of men from 7 to 5 will *increase* the time *in the same degree*, so we put 7 *above* the line and 5 *below*; we see that *increasing* the number of minutes from 315 to 378 will *diminish* the time *in the same degree*, so we put 315 *above* the line and 378 *below*; and lastly, we see that *diminishing* the number of 12ths of an acre from 159 to 148 will *in the same degree diminish* the time, so we put 148 *above* the line and 159 *below*.

Reducing, we find our answer to be

$$\frac{16 \times 63 \times 148}{54 \times 159} = \frac{8 \times 7 \times 148}{3 \times 159} = 17\tfrac{119}{477} \text{ days.}$$

And with the same ease and certainty of going right can all problems in compound proportion be solved, if common sense be applied to determine whether each several change *tends to increase or to diminish* the result sought, the *larger* of the two numbers being put *above* the line in the case of *increase* and *below* the line in the case of *decrease*.

Our Whist Column.

By "Five of Clubs."

The Hands.*

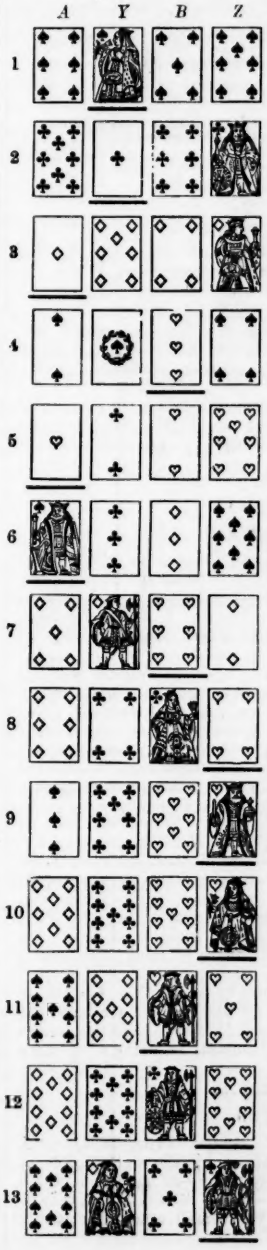
Y.
Hearts—None.
Clubs—A, 10, 9, 7, 4, 3, 2.
Diamonds—Q, Kn, 9, 7.
Spades—A, Q.

B.
Hearts—Kn, 9, 8, 6, 3, 2.
Clubs—Q, Kn, 6, 5.
Diamonds—4, 3.
Spades—5.

Y B
Score.—Three all.
Dealer.
A Z
Trump H.5.

A.
Hearts—A.
Clubs—8.
Diamonds—A, 10, 8, 6, 5.
Spades—K, 10, 9, 6, 3, 2.

Z.
Hearts—K, Q, 10, 7, 5, 4.
Clubs—K.
Diamonds—K, 2.
Spades—Kn, 8, 7, 4.



NOTES ON THE PLAY.

Note.—The card underlined wins the trick, and card below leads next round.

1. *A* leads the anti-penultimate. *Z* begins a signal.

2. *Y* properly leads the Ace of his long suit. *B* begins a signal.

3. *Y* changes his suit. To force his partner by continuing Clubs would be contrary to an important Whist principle, and manifestly dangerous. *B* begins to signal in Diamonds.

4. *Z* completes his signal, but

5. *B* properly leads trumps, despite the signal, having held six originally. The chances are against *Z* holding more than five, and *B* is leading through his strength. *Z* signals in trumps after opponent's lead, and plays the ante-penultimate. He, as it were, *shouts* his strength in trumps.

6. *A*'s not returning trumps *may* not, after *Z*'s play at trick 5, mean that he has none left. But to all the others it should be clear that the chances are he has none. *Y* rightly discards a Club, as *B* holds both the best. *Z* knows *Y*'s suit.

7. If *A* leads a spade here, forcing his partner, and *B* then unwisely resumes the trump lead, *Y Z* will make two by tricks (for *Z* can safely finesse trump 10). But if *B*, being so forced, force in return with Club Queen, *Y Z* will only make the odd trick. *A* rightly leads a Diamond, not only to avoid (if possible) forcing his partner, but because he leads through Y's strength.

8. *B* properly refrains from leading trumps again.

The rest of the game plays itself; *Y Z* cannot prevent *A B* from making one more trick.

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* The game described in part by "Q. T. V.," at p. 93, suggests an interesting and instructive illustrative game, showing how *Y Z*, who lost two by tricks when *Y* forced his partner at trick 3, would have won the odd trick had *Y* then led a Diamond: and two by tricks unless *A B* played correctly. We have fairly distributed the other cards, giving to *B* six trumps as the best way of balancing *Z*'s strength in trumps, and giving *A* the Ace of Diamonds, *Z* the King. It is noteworthy how much signalling there is of all kinds.

XUM

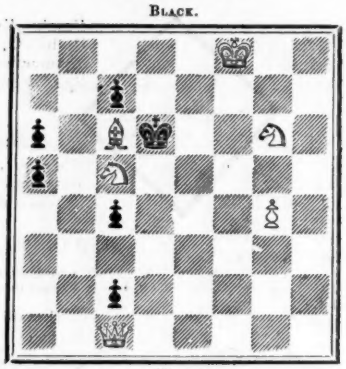
Our Chess Column.

By Mephisto.

PROBLEM No. 75.

By C. Planck.

Black.



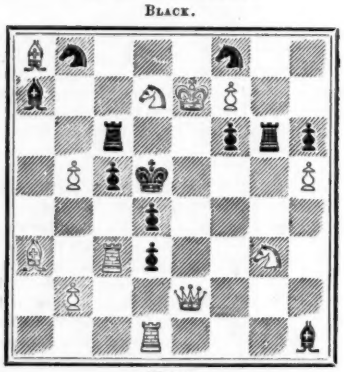
White.

White to play and mate in three moves.

PROBLEM No. 76.

By G. W. Mitchell.

Black.



White.

White to play and mate in two moves.

A remarkable ending occurred to us in a game played last week. We give it as an example of resource in difficulties. A good player will be dangerous to the last, or to use a hibernian phrase, he will not die as long as he is alive. When encountering a strong opponent, players will do well not to relax their attention, even when possessing a great or winning advantage, as otherwise they might be very much disappointed as to the result of their game. It is vexatious to have a game even drawn when victory seemed certain.

Amateur.

Black.

White.

Mephisto.

White played	Q to R7 (ch)	Q to R5
	R to Kt3 (ch)	R takes R
	Q takes R (ch)	Q to Kt5
	Q to R7 (ch)	Q to R5

and the game was drawn by perpetual check. It is obvious that in reply to Q to B5 (ch) Black cannot interpose the Rook, as he would be mated by Q to B sq. (ch).

SOLUTIONS.

Problem No. 72, by John Simpson, p. 78.

(*a*) Mate in three moves.

1. Kt to B7 (ch) B takes Kt, or	1. K to K5 (best)
2. R takes R (ch) Kt to K5	2. Q to Kt4 (ch) K takes R.
3. Q takes Q mate.	3. R to B3 mate.

(*b*) Self mate.

1. Q to B7 (ch)	1. Q or R to Q3
2. R to Q5 (ch)	2. Kt takes R.
3. Q to B3 (ch)	3. Kt takes Q mate.

Problem No. 73, by Sydney Spokes, p. 78.

1. R takes B	1. P takes R
2. B to K8	2. K or P moves
3. Kt to B7 mate.	

On Saturday next Mephisto will conduct twenty games simultaneously against twenty members of the North London Chess Club.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. G.—No, you must not move into check.

Learner.—There is nothing to be said against the opening, except that it requires care on your part, lest a strong opponent may take advantage of it to get you into a bad position.

A Subscriber.—We do not consider the two Knight's Pawns fair odds, as it does not affect the stronger man's game disadvantageously in the opening. Either the King's Bishop's Pawn and one or two moves or the Knight ought to be given.

Problems received with thanks from J. A. Miles, J. W. Combe, and Clarence.

Correct solutions received.—Problem No. 72, W. F. W. R., John Lonsdale, John Watson and R. J. P., sen., (*a*) M. T. H. No. 73, John Watson, John Lonsdale, W. F. W. R., J. Hughes, H. A. D. No. 74, Geo. G., M. T. H., J. A. Miles, Clarence, R. J. P., W., C. W. Combe.

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